Irrigation System Best Management Practices

For optimum maintenance and operation

City of Bellingham

8/4/19

Written by Michael Laurie,
Watershed LLC

Table of Contents

13 BEST MANAGEMENT PRACTICES FOR MAINTENANCE AND OPERATION OF IRRIGATION SYSTEMS

Introduction

This guide is designed to help irrigation maintenance staff find ways to reduce irrigation water use while maintaining or improving the look of their landscapes. The guide is based on work carrying out hundreds of irrigation assessments.

Of all the suggested practices in this guide, the most important is to create an irrigation zone guide with information on the location/irrigation equipment/plant material for each zone and place a copy of that guide inside the controller. A lot of time is wasted trying to find the location of irrigation zones when such a guide does not exist. And having a guide like that in place can allow for more time to investigate the system for savings opportunities.

The second most important thing to do is to turn on the irrigation system and, using the irrigation zone guide, walk around with a clipboard, and note any problems or opportunities for efficiency improvements. Many of the things you will be looking for will not be that hard to fix: things like broken heads, clogged nozzles, low head drainage, blocked heads, and misaligned heads. But if you don't walk around and look at the system in operation a few times per year these problems can persist and waste water for an entire irrigation season.

This guide is not meant to be an in-depth study of all the possible issues and all the details of how to fix them. If you want more information on some of the subjects that follow, consult an irrigation expert, your supplier of irrigation equipment, the catalogs and web sites of irrigation equipment suppliers, or the following web sites:

Smart Water Application Technologies:	Provides up-to-date information on water saving technologies and practices, https://www.irrigation.org/SWAT
WaterSense:	Has helpful information on water saving equipment and practices, https://www.epa.gov/watersense/outdoors

:

BMP #1: Conduct A Basic Walk-Around Irrigation Assessment

Possible problems to look for

Start off by completing a basic walk-around irrigation assessment. This is a simple task that will help you to assess opportunities to improve the efficiency and operation of your irrigation system. Possible problems to look for:

- ✓ Possible leaks and breaks in the irrigation lines and equipment
- ✓ Irrigation schedule not well matched to irrigation equipment, plants, soil, and other site conditions
- ✓ Improperly functioning equipment
- ✓ Some plants no longer need irrigation
- ✓ Beds lack mulch
- ✓ Irrigation heads blocked by foliage
- ✓ Irrigation heads spraying pavement

Remedy/How To

While irrigation system is off, locate irrigation meter and check for indication of water flow which suggests there are leaks.

Locate irrigation controller and note if it has a listed description of the zones and a schedule. If there is a posted schedule check controller to see if posted schedule matches what is in controller. Check to see if sensors are active.

Turn on controller for test run of 3 – 4 minutes for each zone and walk around with paper and clip board to note problems in each zone, whether existing zone description is accurate, and unless zone description is accurate, and add information on plant material and irrigation type for each zone if it is not on the existing description

Why this action is important

- Helps improve landscape health and appearance.
- Saves time and money on maintenance and water. Running an irrigation system all summer without checking it out a few times is certain to lead to major water waste from breaks, leaks, and other problems that can go undetected.
- Preserves our high-quality water source—and salmon habitat.
- Avoids public relations problems that can come from an irrigation system spraying water on the sidewalk, running in the rain, or leaking a large volume of water from a break.

The chart on the following page outlines in detail the steps to follow for an irrigation assessment.

Basic Irrigation Assessment

Activity	Steps
CHECK METER, CONTROLLER AND PROGRAM RECORD ✓ Check meter for leaks ✓ Confirm schedule / seasonal adjust ✓ Confirm conservation practices ✓ Create maintenance/repair lists	1. Note zone description/ current schedule on form. 2. Locate meter and check leak detector. 3. Locate controller and note if it has: a. Sensors Active? Rain, flow, soil moisture and/or solar b. Posted zone descriptions / programs? c. Different programs for turf and beds? d. Using season % adjust?
Review irrigation scheduling ✓ Basis for schedule refinement ✓ Document to ensure continuity	See **Common Features of Irrigation Controllers, and Their Functions** on next page.
Observe landscape plantings and soil ✓ Identify washouts, pavement watering, plant death/stress. ✓ Check soil in numerous places, especially trouble spots. ✓ Select zones to run / scrutinize (if site too large to run all zones)	Observe and note: 1. Obvious runoff on paving, wet walls, soil washed out. 2. Turf a. Unintended brown areas (or green areas) b. Soggy areas? c. Thatch d. Soil type and depth 3. Beds a. Stressed or dead plants b. Soil type and depth* c. Mulch on beds d. Established plants that no longer need irrigation? e. Moisture matches exposures: N. and E. shadier—shrubs need little irrigation; S. and W. hot and dry *Soil and roots **Sand** holds little water-needs watering often. **Clay** lets water in slowly—needs multiple short run times. **Loam** good balance of infiltration and storage.
Observe system in use ✓ Identify problems preventing efficient irrigation ✓ Evaluate if irrigation type and schedule appear appropriate	Identify obvious problems: a. Broken heads or pipes b. Leaky nozzles, seals c. Sprinklers blocked by foliage, too low in turf d. Misdirected sprays, wrong pattern on nozzle e. Low-head drainage, f. Unnecessary or unintended irrigation.

BMP #2: Create an Irrigation Zone Guide to Place Inside the Controller

This effort is very similar to the previous effort, but the key difference is that the goal of the previous effort is to find and fix problems. The goal here is to create a guide to the 'what and where' of each irrigation zone.

Possible problem to be solved

Many irrigation staff people, especially when they are new to a site, can spend many hours just trying to figure out where all the irrigation zones are located, what kinds of plants are there, and what kinds of irrigation equipment are there.

Because they spend so much time trying to find zones and figure out plants and equipment located there, it reduces the time they have available to try to make the system more water efficient.

Remedy

Create an irrigation guide. If you create an irrigation guide to put inside your irrigation controller, it will save time for staff when they try to find the location of zones. It will also tell at a glance whether the watering schedule is customized to the plants and irrigation equipment, or if it was programmed too hastily. For example, if the guide inside the controller says that zone 1 sprays on beds with well-established perennials and it is set to water 30 minutes/ 3 days/week and zone 2 is rotors on turf grass and it is *also* set to water for 30 minutes/3 days/week, the irrigation schedule is clearly not matched to the different water needs of these different plants and the different water outputs of these different kinds of irrigation heads.

How to create an irrigation guide: Turn on the irrigation controller to run for 2 – 4 minutes for each zone. Walk around with a clipboard and camera and for each zone note the location, plant type, and irrigation type.

Why this action is important

It saves time and money; especially with new employees who don't know the location of the zones. The saved time can be used to make improvements to the water efficiency of the system. The next page shows an example of an Irrigation Evaluation Form, used to create the Irrigation Zone Guide. In this case it also includes some proposed changes for the system. It can be useful to include a guide with suggested changes to see if over time the changes are made.

Irrigation Evaluation Form Example

Facility/Contractor: Bellevue High School, 601 108TH AVE SE. On April 22nd those present were Michael Laurie, Ryan Vucinovich, Shawn Anderson, and Patrick Richards. On May 13th those present were Michael Laurie, Ryan Vucinovich, Shawn Anderson, and Morgan Shimabuku.	Date: April 22nd and May 13th

Controller Location South of school entrance near Tennis Court	Program	Run Days	Start Times	Season Adjust?
Controller: Model: Rainbird ESP-LXME. Main controller for campus. Can be controlled from hand held radio control. This is the 2nd year this is in use. Challenge here is that because it is new plantings the programming has been done by the plant installers, the landscape architect, and staff without clear understanding of what each party is doing. Most of the spray heads are SAM and many zones have MP rotators	A	3 days/week	4 AM	Has monthly seasonal adjust feature but it is only sometimes adjusted. Could save by making better use of this feature
	B	Every day	1:00 AM	

Zone: Location / Plant Types / Exposure	Irrigation Type	Current Peak Summer Program		C and D	Not used		Proposed Peak Summer Schedule based on catch can test results
		Run Time	Run Days	Problems / Repairs		Location	

1	Shrubs, <u>N. Tennis Court bed</u> Low water need plants	Pop Up Sprays	A - 15 mins.	3 days/ week	Break in line No MP rotator nozzles, could use them	**Program A** **15 mins,** **3 days/week**
2	Shrubs including Red flowering currant, sword ferns, kinnikinnick. Partial slope <u>SE of Gym</u> Low water need plants	Pop Up Sprays	A - 15 mins.	3 days/ week	MP, low pressure, could go drip	**Program A** **15 mins,** **3 days/week**
3	<u>Building Line Weight Rm.</u> Low water need plants	Pop Up Sprays	A - 15 mins.	3 days/ week	No MP rotator nozzles could use them One break	**Program A** **15 mins,** **3 days/week**
4	<u>West 108th Lawn</u>	Rotors	A - 15 mins. B - 10 mins	A - 3 days/ week B – 7 days/ week	Pressure too high. Replace nozzles with MP rotators to get more even coverage	**Program B** **15mins,** **7 days/week**
5	<u>108th Lawn East</u> Turf	Rotors	A - 15 mins. B - 10 mins	A - 3 days/ week B – 7 days/week	Fairly good head to head but nozzles not all the same. Replace all nozzles with MP rotators to get more even coverage. 1 head missing nozzle	**Program B** **15 mins** **7 days/week**

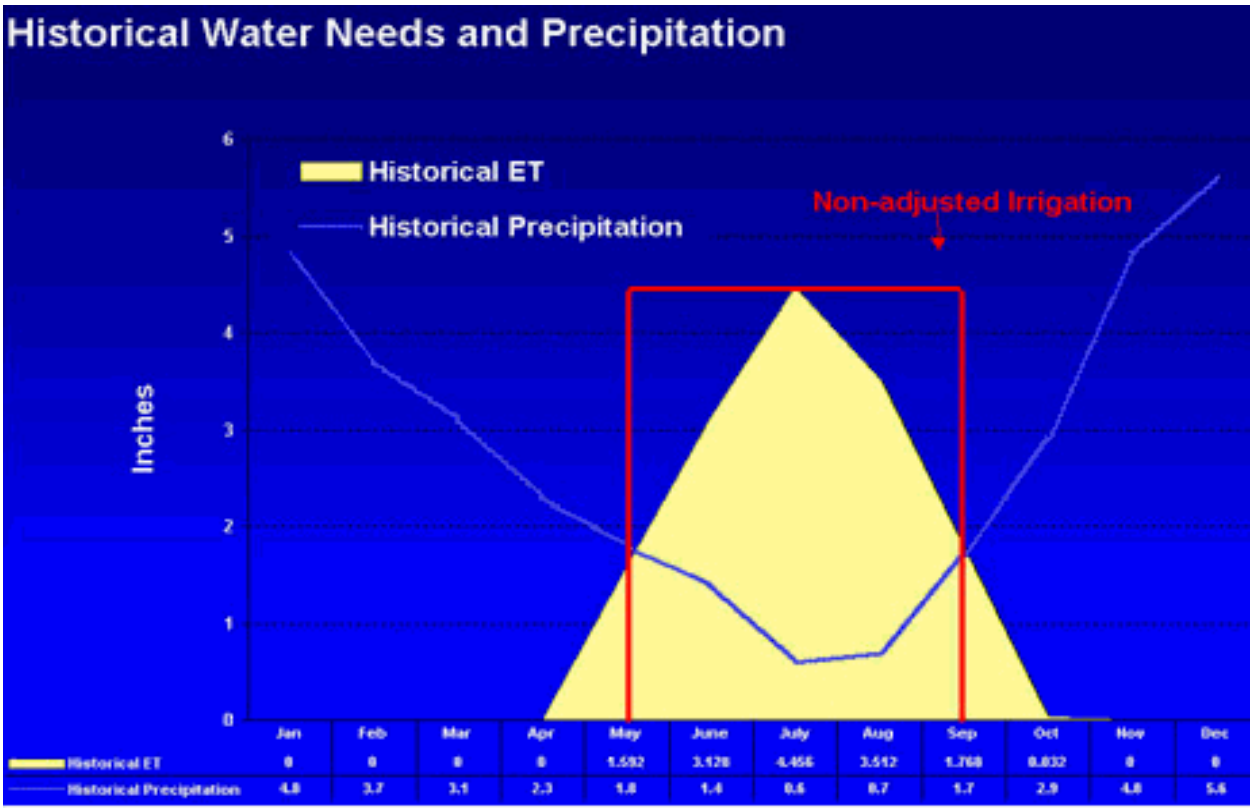
BMP #3: Change Watering Schedules to Match Changing Weather

Possible problem to be solved

Many people set their irrigation controller zones once and let it run for those days and times for the entire irrigation season. This wastes water because typically in the beginning and end of the irrigation season, in rainy periods, and cool periods, less or no irrigation is needed.

In the diagram below, "Historical Water Needs and Precipitation" if you set the controller to deliver the irrigation needed in the peak of summer, you would irrigate with water that would fill in the red box. But the blue areas in the red box would be an estimate of the water you would have used unnecessarily.

Historic water needs and precipitation for Western Washington State



Remedy

The ideal, efficient watering schedule would be the amount in the yellow pyramid. The challenge is that to follow a watering schedule close to the yellow pyramid, basically watering based on the weather, would require changing the watering schedule almost every day. No one has the time for that. There are three solutions:

1. The quick, low cost option is to set the watering schedule based on the watering needs of the hottest, driest part of the summer and then in Spring and Fall use the percent adjust button on the controller to reduce the times by about 20%.
2. The second option is to learn if your controller can be retrofitted with either soil moisture sensors or weather sensors. If it can be retrofitted, consider installing a sensor to allow sending signals to the controller every day to adjust the watering based on weather or soil conditions. Talk to your local irrigation equipment supplier or irrigation contractor, and/or consult web sites and catalogs of suppliers to learn about the options and choose one that makes the most sense for you. Proper programming is critical to success.
    a. Weather sensors: Many controllers can be retrofitted with sensors to create weather-based scheduling. Examples of products are Hunter Solar Sync Sensor Module, Rain Bird ESP4SMTEUPG Upgrade kit, Irritrol Climate Logic® Weather Sensing System, Hermit Crab retrofits, and others.
    b. Soil moisture sensors: There are new products that improve soil moisture-sensing accuracy. There are several available as add-on modules, but others only work with some controllers. Most sites will likely require installation of multiple sensors to account for varying sun exposures, soil types, and irrigation uniformity.

Soil moisture sensor

3. The third option is to replace your controller with a weather-based irrigation controller, set the watering schedule based on the watering needs of the hottest driest part of the summer, and the controller will automatically adjust the watering schedule to match the changing weather every day. Pick a SWAT tested and approved controller. In that way, you will be picking one that third party testing shows to work well. https://www.irrigation.org/SWAT

Weather-based controller

BMP #4: Use These Tools to Help Manage the Irrigation System

Possible problem to solve

Differences in soil depth and soil type play a big role in how best to manage your irrigation system, but you may not have a good tool that allows for quick checking of the soil. Excess pressure or too low of pressure can impact proper irrigation system management, so having tools to check the pressure are essential.

When checking the operation of the irrigation heads in each zone you will find heads that need adjustment or nozzles that need unplugging. You may want to make changes to existing equipment but you may not know what changes are possible or what replacement equipment is available.

As you look at your system in operation, you may see problems that you don't have time to address right away or that you want to ask someone else to address.
Also, as you look at your system in operation you may not have a quick way to note the problems you discover or where they are located.

Remedy

Use the right tool to address your problem. Here are a few helpful tools and the situation they are most relevant for:

- Soil Core Sampler – A great tool for taking a quick sample of the soil to show soil type and depth.
- Pressure gauges for spray heads and rotors – The tools to use for measuring the pressure at irrigation heads.
- Irri-tool and rotor adjustment tools – These and other tools can help you make adjustments on the spot.
- Catalogs for Rainbird, Hunter, Toro, Irritrol, and other companies – To learn about existing and new products. http://www.rainbird.com

Soil core sampler

Irri-tool

- Camera – To quickly capture a photo of a problem to address later or with others' help.
- Irrigation Zone Guide – A way to document the details of a problem and which zone it is located in.

Why this action is important

Using the right tools can save time in addressing problems in the system. It will also save water and money on the water bill because you can address the problems more quickly.

BMP #5: Consider the Soil

Possible problems to solve

You may have soil that varies in different parts of your irrigated landscape. Some areas may be sandy, others may have hard clay, and some might have nice loamy soil. You may be wasting water because the best way to water will vary between these different soil types.

For example, it is best not to water for too much time at once on a sloped, clay soil because some of the water will run off. But loamy soil can hold more water so a longer run time may not waste water there. Another area with sandy soil will tend to drain some of the water away quickly, so sandy soil should also not be watered for too many minutes at once.

Remedy

Example of good, deep, loamy soil captured by soil corer

Use a soil corer to check out the soil around your irrigated landscape. Make note of the soil types in each area and how deep the soil is.

For the areas with sandy soil, you can add compost to convert them to more loamy soil that can hold on to and make better use of water. Clay soil can also be improved with the addition of compost but it may need to be broken up first to allow the compost to blend in.

Ideally you want dark, loamy soil with a lot of organic matter. Soil texture and depth determines water storage capacity / irrigation frequency.

For new landscapes, you should start with >8” of compost-amended soil, plus sub-grade loosened 4” deep. Deeper soil stores more water, reduces plant stress and irrigation need. Organic matter holds water. Thatch stops water from reaching roots.

Why this action is important

Improving the soil saves water and money on the water bill because you can change the watering schedule to work with the soil types that you have. You will also save water and money on the water bill because you reduce water waste. And you will save water and money on the

water bill because you improve the water holding and using capacity of some of the soils by adding compost. Also, the plants will be healthier if you add compost.

BMP #6: Choose Plants Wisely

Possible problems to be solved

The plant varietals selected can impact water consumption. High water-need plant choices lead to an excessive use of water. When high and low water need plants are planted in the same zone, it often leads to a situation where the zone is either watered too much for some plants which might result in disease and other plant health problems or too little for some plants which will make it difficult for them to survive.

Plant varieties have been chosen that are more prone to disease and pest problems.

Plants have been planted in soil or sun locations that are not a good match to what they need and the plants are not showing good growth.

Remedy

Use the following guidelines to choose drought tolerant plants, plant varieties more resistant to disease and insects, plant plants in the areas they prefer, group plants with similar watering needs in the same irrigation zones.

- Use drought-tolerant plants that need little or no irrigation after 2-3 years.
- Concentrate plants with higher water needs in just a few irrigation zones.
- Group plants with similar water needs in the same zone.
- Minimize irrigated turf.
- Using drought resistant plants, and grouping plants with similar watering needs, can reduce the water use 30% or more. And there are many beautiful, lower maintenance plants that need less water.
- Consult the following web sites for information on native and drought tolerant plants:
  - Washington Native Plant Society List of plants that are native to Whatcom County http://www.wnps.org/plant_lists/counties/whatcom/whatcom_county.html
  - Great Plant Picks Plant Lists, many of the lists are for drought tolerant plants http://www.greatplantpicks.org/plantlists/search/
  - Saving Water Partnership Plant List http://www.savingwater.org/cs/groups/public/@spu/@conservation/documents/webcontent/spu01_003855.pdf
  - Northwest Native Plant Guide https://green2.kingcounty.gov/gonative/index.aspx

Why this action is important

You can save water and money on the water bill because you can water the drought-tolerant plants less, and plants will be healthier. Below are some suggested plants.

Wild Ginger, Asarum caudatum

Oregon Grape, Mahonia aquifolium

Angelica, Angelica archangelica

BMP #7: Mulch

Possible problems to be solved

Soil is drying out often, leading to the need for excess watering.

Soil is getting hardened by heat and drying from sun which makes it harder for water to penetrate.

Staff are spending many hours weeding or making use of herbicides that can be harmful to the plants you want to keep and to the beneficial soil organisms.

Remedy

Maintain 2” or more mulch on beds. It will keep the soil moist, reduces water needs 50% in annual gardens and wide-spaced shrub/perennial beds. Keeps soil loose and absorbent. Smothers weeds that steal water from desirable plants.

Guidelines for applying mulch:

- Mulch whole beds, or 3’+ rings around trees in lawns.
- Trees & shrubs: 2-4” wood chips or “medium-fine” bark. Replenish when decomposed – don’t apply too often.
- Annuals, perennials, berries, roses: 1-2” of compost, manure or straw each year.

Mulch example

Why this action is important

Mulching reduces irrigation water need which saves money on the water bill. Mulching also reduces weed growth which saves on time required to weed beds.

BMP #8: Stop Low Head Drainage

Possible problems to solve

Low head drainage is the leakage problem that sometimes occurs at the bottom of sloped irrigation zones. In some cases when the irrigation zone is turned off, water leaks out of one or more of the lowest heads in the zone, because of all of the pressure built up from the water uphill from that spot.

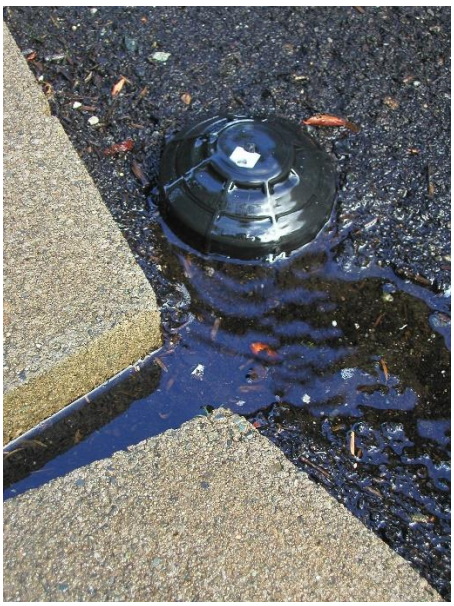
This can waste many gallons each time a zone runs / shuts down.

Remedy

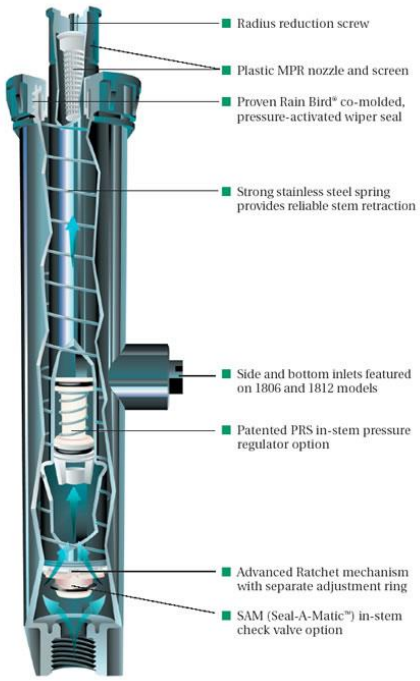
Replace lowest sprinklers in affected zones with sprinkler bodies with check valves and powerful springs. Install check valve retrofit for rotors. And, install in-line check valves.

Why this action is important

Save water and money on the water bill because you stop water from leaking out of the irrigation line each time it shuts off.



Example of low-head drainage



Spray head with check valve to stop low-head drainage

BMP #9: Use Efficient Nozzles

Possible problem to be solved

In many irrigation zones, there are nozzles that spray water out in a range of patterns. Some might put the water out in a 90-degree range, others at 180 degrees, and some at 360 degrees. Unless the nozzles have what is called matched precipitation rates, the water coming out of the 90-degree nozzle puts out 4 times as much water per square foot as the 360-degree nozzle. This means that if a zone with 360-degree nozzles needs to be run 4 times longer than zones with 90-degree nozzles.

Remedies

Example of an efficient nozzle

Install matched precipitation rate nozzles that will even out how much water comes out even though the nozzles may vary from 90 to 360 degrees in the arc they put the water out at. This is essential for efficient turf watering, but not for shrubs, because their roots spread more. Sprays retrofitted with "High-Efficiency" nozzles can save 10-20%. You may be able to upgrade rotors, but may need to rebuild the zone.

Why this action is important

Save water and money on the water bill because you don't have to over-water large parts of the zones to ensure that all areas get enough water.

BMP #10: Install Master Valves

Possible problem to solve

Hidden leaks can waste water because they leak water all day long until you learn about the leak, find it, and fix it.

Remedy

Installing a Master Valve can ensure that when the system develops a break or leak that it only wastes water for the hour or two each day that it is running until you find and fix the leak or break.

Master Valve shuts off water to entire system when no zones running; or if leak detected by flow sensor. This stops leaks in main line or at zone valves from running 24/7.

Installing a Master Valve san save 1,000's of gallons in a single line break.

Master Valve

Why this action is important

Save water and money on the water bill by reducing water loss from leaks and breaks until they are found and fixed.

BMP #11: Reduce Excessive High Pressure

Possible problem to be solved

High pressure water can waste 10-20% of water through misting, and wears out equipment.

Remedy

A pressure-reducing valve in the right place can solve misting problems for little $$.

The best place for the pressure reduction depends on the system, how high the pressure is, and the equipment. Reducing the pressure too much at the front end of the system may lead to low pressure at the end of the farthest zones. It may be that most zones and heads have good pressure but that a few zones have excessive pressure and those zones could benefit from installation of a pressure-reducing valve.

Example of too high pressure leading to water blowing

Why this action is important

Save water and money on the water bill because you reduce water lost to mist from high pressure.

BMP #12: Install Flow Sensors

Possible problem to be solved

Leaks, breaks, and stuck heads go undetected.

Irrigation head break that might go undetected if system operates at night

Remedy

Flow sensors will send a signal to let you know that there is a problem in the irrigation system that needs attention now. Without this equipment and without checking meters and billing, water waste from a problem could go on for years.

Flow sensors measure flow data and send signal to controller. Compatible controllers learn each zone's flows, and detect low or high flows caused by broken pipes or heads, or stuck valves. Some controllers isolate & shut down problem zone and continue irrigation elsewhere. Some shut off all irrigation—so if system is not networked, controller must be checked onsite frequently for warning light.

Why this action is important

Save water and money on the water bill because you can get a message that there is a problem as soon as it is detected.

Flow sensor

BMP #13: Install Drip Irrigation Where Appropriate

Possible problem to be solved

Pop-up spray heads in planting beds can waste up to 50% of the irrigation water.

Remedy

Convert pop-up spray head zone to drip irrigation. A conversion can be accomplished in most bed zones by replacing a few heads with connection units with built-in pressure regulators and filters, and drip lines can be run from these units. This allows for capping the other spray heads on the zone. Whichever drip technique you decide to use, be sure to add a filter and pressure reduction.

Kit to retrofit spray to drip

Why this action is important

Drip spray example

Save water and money on the water bill because you reduce the water wasted with spray head irrigation on a bed zone.

Provides more uniform watering because, unlike spray heads, drip is not blocked by large shrubs.
Reduces weeds, plant diseases, and pests.

It is also great for watering containers and narrow and odd-shaped beds.